نطابق حدود المعدلة اعلاة مع حدود معادلة السوال ثم عوض عن قيمة $R_F = 10K\Omega$ كما يلي

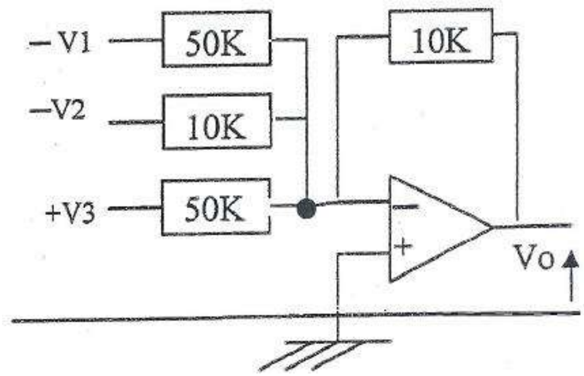
$$\frac{R_1}{R_F}V_1 = 0.2V_1 \ then \ R_1 = \frac{R_f}{0.2} = \frac{10}{0.2} = 50K\Omega$$

Also

$$\frac{R_2}{R_F}V_2 = V_2 \ then \ R_2 = \frac{R_f}{1} = \frac{10}{1} = 10K\Omega$$

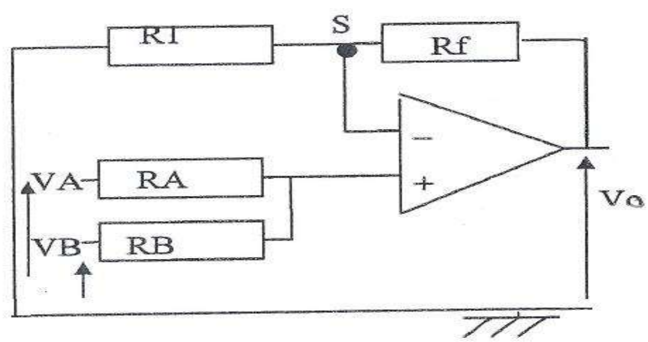
And

$$\frac{R_3}{R_F}V_3 = 0.2V_3 \ then \ R_3 = \frac{R_f}{0.2} = \frac{10}{0.2} = 50K\Omega$$



4.5 Non-inverting Adder

Non-Inverting Adder: - It is one of the non-inverting op-amp application



ان نقطة الإضافة (S) في الشكل لن تكون ارضي ظاهري، حيث تكون ارضي ظاهري عند ربط الادخال غير القالب الى ارضي فقط. لذلك عند اخذ (VA) بالاعتبار عند تطبيق نظرية التراكب، وبعد قصر (VB) فأن الجهد المجهز الى الدخل غير القالب يتم تحديده بتطبيق قاعدة مجزئ الفولتية: -

$$V_{in1} = \frac{R_B}{R_A + R_B}V_A \qquad (1)$$

The output voltage from point V_A

$$V_{out1} = (\frac{R_B}{R_A + R_B}V_A)(1 + \frac{R_f}{R_1}) \qquad (2)$$

$$V_{in2} = \frac{R_A}{R_A + R_B}V_b \qquad (3)$$

The output voltage from point V_B

$$V_{out2} = (\frac{R_A}{R_A + R_B}V_B)(1 + \frac{R_f}{R_1}) \qquad (4)$$

The output

$$V_o = V_{out1} + V_{out2} \qquad (5)$$

$$V_o = \left(\frac{R_B}{R_A + R_B} V_A\right)\left(1 + \frac{R_f}{R_1}\right) + \left(\frac{R_A}{R_A + R_B} V_B\right)\left(1 + \frac{R_f}{R_1}\right) \qquad (6)$$

By adding terms yields:

$$V_o = \left[\left(\frac{R_B V_A + R_A V_B}{R_A + R_B}\right)\right]\left(1 + \frac{R_f}{R_1}\right) \qquad (7)$$

If $R_A = R_B$ then

$$V_o = \left[\left(\frac{V_A + V_B}{2}\right)\right]\left(1 + \frac{R_f}{R_1}\right) \qquad (8)$$

4.6 The Subtractor

By using superposition theorem: -

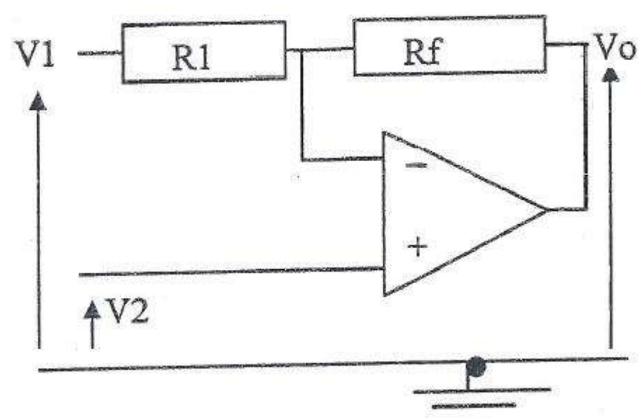
$$V_o = V_{out1} + V_{out2} \qquad (1)$$

Where,

V_{out1} is the output from V_1

And

V_{out2} is the output from V_2



$$V_{out1} = V_{A1} \times V_1 \qquad (2)$$

$$V_{out1} = -\frac{R_F}{R_1} \times V_1 \qquad (3)$$

$$V_{out2} = V_{A2} \times V_2 \qquad (4)$$

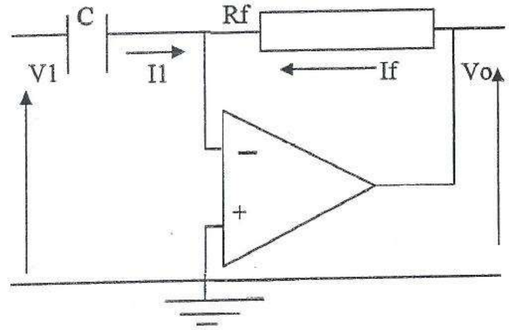
$$V_{out2} = \left(1 + \frac{R_F}{R_1}\right) \times V_2 \qquad (5)$$

Sub. eq(3) and eq(5) in eq(1) yields:-

$$V_o = \left(1 + \frac{R_F}{R_1}\right) \times V_2 - \frac{R_F}{R_1} \times V_1 \qquad (6)$$

4.7 The differentiator

The Differentiator: - it is one of inverting op-amp applications as shown in figure bellow.



$V_o = I_f \times R_f$ (1)

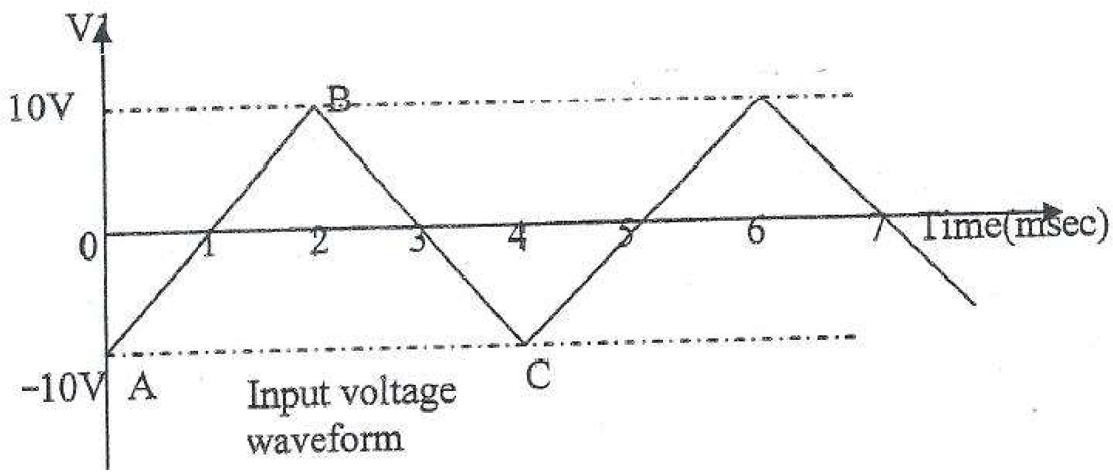
$I_1 = -I_f$ (2)

$I_1 = C\frac{dV1}{dt}$ (3)

Therefore: -

$V_o = -R_f C\frac{dv1}{dt}$ (4)

Ex: For the differentiator shown in figure above; if Rf= 10KΩ and the value of the capacitor is 0.001µF, the input signal is given in Fig bellow. Find the output voltage waveform



Sol:-

من الشكل نلاحظ ان تغير الإشارة خطيا من A الى B وبقيمة ميل ثابتة تمثل المشتقة وتحسب كما يلي:-

$$\frac{dv1}{dt} = \frac{+10-(-10)}{2\times10^{-3}-0} = \frac{20}{2\times10^{-3}}$$

$$\frac{dv1}{dt} = 10^4 v/sec$$

And

$$Vo = -RfC\frac{dv1}{dt} = -(10^4)\times(0.001\times10^6)\times(10^4 V/s) = -0.1V$$

وبنفس الطريقة يحسب الميل لشكل موجة الدخل بين النقاط B و C وكمايلي:-

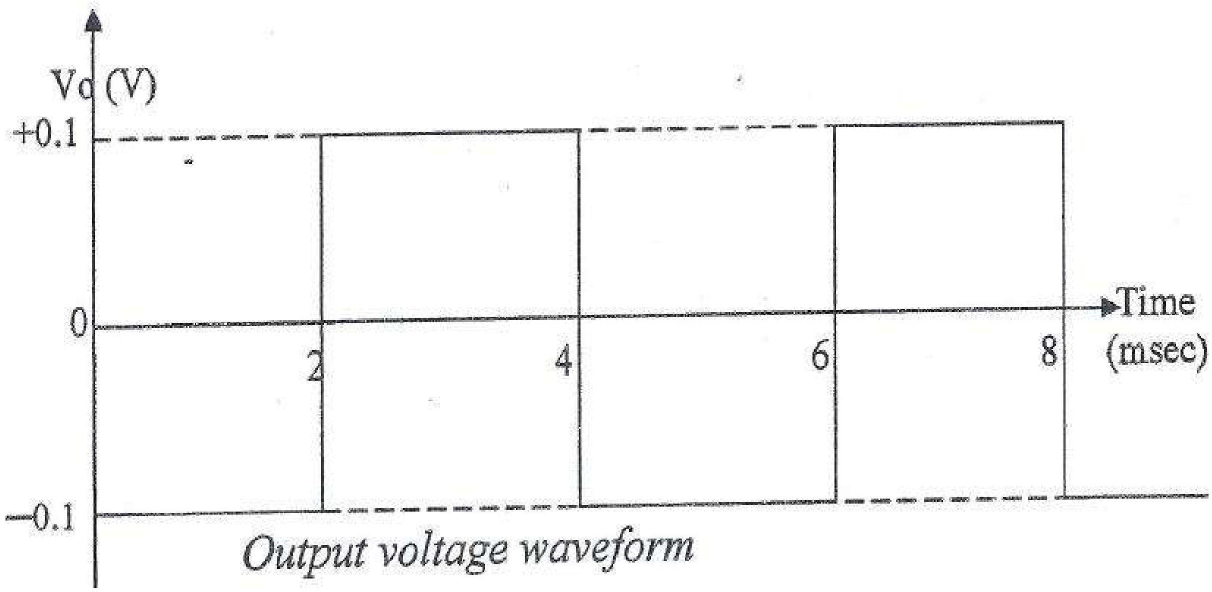
$$\frac{dv1}{dt} = \frac{-10-(10)}{4\times10^{-3}-2\times10^{-3}} = \frac{-20}{2\times10^{-3}}$$

$$\frac{dv1}{dt} = -10^{4} v/sec$$

And

$$Vo = -RfC\frac{dv1}{dt} = -(10^{4})\times(0.001\times10^{6})\times-(10^{4}V/s) = 0.1V$$

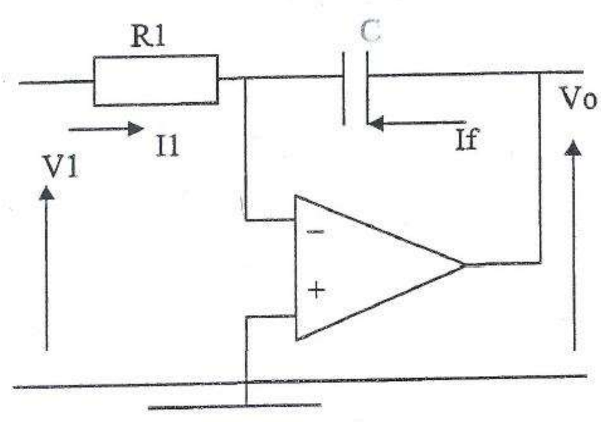
وبذلك يكون شكل موجة الإخراج كالاتي :-



Output voltage waveform

4.8 The Integrator

The Integrator: - It is one of the inverting op-amp application as shown in figure bellow.



$I_f = -I_1$ (1)

$I_f = C\frac{dVo}{dt}$ (2)

$I_1 = \frac{V1}{R1}$ (3)

Sub. (2) & (3) into (1)

$C\frac{dvo}{dt} = -\frac{V1}{R1}$ (4)

Integrate both side of eq.4 and solve yields: -

$Vo = -\frac{1}{R1C}\int V1\, dt$ (5)